497

THE ROLE OF A UNIVERSITY IN CITY TRANSFORMATION

Nastaran Namvar; Amira Elnokaly; Glen Mills

ABSTRACT

This research investigates the reciprocal spatial impact of universities and their host cities. The study carries out a cross-case analysis between the University of Lincoln and city of Lincoln and with the University of Worcester and the city of Worcester. Both cities are located in United Kingdom (UK), have similar historical backgrounds, and are similar in terms of size and population demographic. Additionally, both universities are relatively new universities.

This study attempts to uncover and clarify how the University of Worcester and the University of Lincoln have transformed their socio-economic and spatial environments in their respective cities. One of the most significant features of this transformation is related to spatial integration and connectivity between the campus and city. This is a complex relationship, that is dependent on many physical and non-physical variables.

This paper presents the results of that highlight the spatial configuration of the city/ campus relationship. Space Syntax techniques and observation data are adapted in order to show how campus layouts influence the spatial configuration of the city. The main finding in this research shows that the location of a university campus has a significant impact on the city in physical, social and economic forms.

KEYWORDS

Space Syntax, city, campus, spatial transformation

1. INTRODUCTION

Urban space transformations are including direct changes to the physical components of the city, and these changes integrate with the changes of the social composition and socio-cultural dynamic nature of the community (Elnokaly and Elseragy, 2012; Macionis and Parrillo, 2016). In fact, a city is a combination of spaces which is shaped and developed by the society that inhabits it. On of this spaces in the city that play a major role to shape the city and the society is higher education institutes. As Ansell mention at Going Global conference in 2017, a fundamental inter-relationship pertinent to spatial- cultural dynamics that has been noticed in many UK cities is that between the university and the city. The relationship between Universities and cities has become increasingly important in the recent decade. This link pertains to the economic, physical, geo-political and cultural facets of city life (Heijer, 2011; Goddard, 1994; Heijer and Magdaniel, 2012; Vallance and Goddard, 2013; Wiewel and Perry, 2015; Way, 2016). As universities contribute more and more to the local economy through research, reputation and the creation of capital infrastructure in the form of campus development, they are seen not only as educational and cultural institutions but also viewed as a mainstay for urban transformations. Several literatures have discussed the economic impact that the university has on the city (Rauch, 1993; Glaeser, 1998; Simon, 1998; Mathur, 1999; Universities, 2015; Oxford Economics, 2017). These literatures identify important roles played by a university in

impacting cultural development in the city through the process of recruiting a range of creative professionals to the city. The other studies address some issue the quality of the university campus concerning educational, physical and social life inside the campus and the neighbourhoods around the university (Hermke and Helsper, 1990; Hajrasouliha, 2017; Robert, 2001; Lau and Yang, 2009; Haggans, 2015; Hajrasouliha, 2016). This paper seeks to highlight the relationship between the university campus and the city with focusing on the physical location of the university campus. The physical location of the campuses, according to Den Heijir (2008), is categorised in three different categories: the integrated-city in which the campus is situated in the middle of the city and integrated within a city; the gated campus where the campus is located in the city and surrounded by a gate; and the separated city where the campus is located out of a city. It aims to contribute to improving knowledge about city and University relationships by analysing a number of different cities in the UK. It also examines the impacts of the university on the city in terms of physical location factors and how the city responds to these effects. Given this relationship between the university and city this study attempts to highlight and understand how the spatial configuration of the university campus impacts on these respective cities. It should be noted that this paper is part of the larger study looking into several universities and cities in the UK. However, for the prepare of this paper, University of Lincoln and city of Lincoln and University of Worcester and city of Worcester are used as the case cross compression to represent and discuss the city/campus duality.

2. DATASETS AND METHODS

This paper applies a mixed method to address the questions associated with this research objectives. Mixed method in this research includes Space Syntax method (Hillier and Hanson, 1984), observational research (Vaughan, 2001) and. Space Syntax approaches were established in the Bartlett School of Architecture, at University College, London (Hillier and Hanson, 1984; Hiller, 1996). A prologue to the analytical technique was developed in an article published in the journal 'Environment and Planning' (Hillier et al., 1976). The space syntax method outlined in Hillier's study illustrate the physical transition to spatial configuration studies by delivering the social approach. Furthermore, many additional studies have been conducted using this approach to the analysis of spatial patterns, and these studies have demonstrated that there is a clear relation between the social and the spatial in the built environment (Hillier and Hanson, 1984; Kim, 1999; Walford et al., 2011). Spatial configuration is one of the essential parameters that shows the probability of increased interactions and encounters of people within a given space (Dawson, 2003). In this context, in-depth research has been done, which shows that people interact more in integrated spaces rather than segregated spaces in the city (Hiller ,1996). In the Social Logic of Space (1984), Hillier introduces a method of nodal and linear definitions of space. The primary technique here involves breaking down axial maps and turning them into sets of perceivable observations (Penn, 2003). A general plan obtained by connecting these lines to each other is called an 'axial map'. The axial map is formed by drawing the fewest and longest straight 'lines' on the map to cover all the spaces within which a user can see and move. As a general rule, whilst navigating space individuals prefer to walk along in the straight line rather than change the direction, unless they have a reason to change direction. Furthermore, the way that users choose to walk in a space is more related to the number of available options open to them in various directions. Such choices are defined by the number of intersections or points along a given axial line. The critical descriptor of the interconnectedness of the axial map, integration was used in this paper. Integration is used to describe the position of space in relation to all other configuration; as a rule, the less depth complex exhibits as a whole, the more integrating the space is, and vice versa (Hillier, 2008). Integration is one of the most important keys to understanding the relationships between the urban space and its users because it directly links to the presence of people at a given location. This measure can be applied to predict the potential of users to meet in a space. In the integration map, see Figure 2-5, different

colours as used to represent the spaces that are segregated and integrated. Integration values are ranked from red to blue. Red shows a space is high integrated, yellow shows the moderate integrated spaces, whilst dark blue shows the least integrated spaces. Integration can be divided into two categories, namely global and local integration. Global integration [HH] is measured all over the system. It takes into account the distances from the starting point to all points in the system (Hillier and Hanson, 1984). Local integration [R3] shows the scale of the pedestrian movement within specific distances or specific areas of the city. The relationship between the global integration [HH] and local integration [R3] is understood as the readability or clarity of a space. If there is a good correlation between global and local integration, then users are able to move freely along axial lines within a given space and can identify where they are in the context of the city of a whole (Stachniss et al., 2012).

The other method that is used in this paper is 'observation method' (Vaughan, 2001). By observing people, it is possible to understand the environmental behaviour of how people interact with the urban space without knowing anything of their specific aims and objectives (Vaughan, 2001). In this study, the best means of observing people is to use Vaughan's (2001) method of the 'gate count'. The data from observational fieldwork conducted in this study was collected with precision and quantity and at many locations. Using this method observational recordings include pedestrians, cyclists and vehicles. The results of this analysis as confirmed Space Syntax modelling and it can provide a better knowledge of human behaviour in urban space. As a result, observational analysis can aid in the understanding how the movement patterns of people shape the city, and how the urban design impacts the behaviour of inhabitants. In this research, the observer observed the movement behaviour at the University campuses and surrounding areas. Observations used gate counts to establish the flows of people at specific locations around the campus over the course of a week (includes weekdays and weekend). A gate is a conceptual line across a street, and gate counts entail counting the number of people, vehicles and cycles crossing that line. The observer stands on the road and counts the number of objects passing the gate in either direction. For this purpose, 7 gates established and counted the number of objects crossing them. 5-minute samples were taken from each gate in 4 cycles throughout the day, from 8 am to 5 pm over a week. The data results of observation will be presented by heat map which created thorough the Quantum geographic information system (QGIS) mapping technology (Graser, 2013).

3. CASE STUDIES AND HISTORICAL BACKGROUND

3.1 CITY OF LINCOLN AND UNIVERSITY OF LINCOLN

The city of Lincoln is county town of Lincolnshire (Figure 1a). Lincolnshire is part of the East Midlands, located on the East coast of England, stretching across to the north of Norfolk and the south of Yorkshire and nestled between the Humber and the River Wash (City of Lincoln Council, 2013). Lincoln is a small, densely populated city comprised of 36 square kilometers, and has an estimated population of 97,795 in 2016 (City of Lincoln Council, 2016). With many younger residents who are largely students, it differs in its demographic character from the rest of Lincolnshire (Office For National Statistics, 2012). The city is rich in both history and architecture, which dates from the pre-Roman era (Kemp, 1992). The University of Lincoln started in 1861 under the name of the Hull School of Art, later on, become as Hull College of Higher Education, in 1979 after merging with other colleges of (The Independent, 2014). A while later in 1992 gained the university status, and renamed the University of Lincolnshire and Humberside in 1996 when the moved the campus to Lincoln (The Independent, 2014). In 2001 moved to the main campus in Brayford pool and since that time known as the University of Lincoln (University of Lincoln, 2015). This educational instituted named Humberside College of Higher Education. In 1992 became the University of Humberside and in 2001 the changed the name to University of Lincoln.

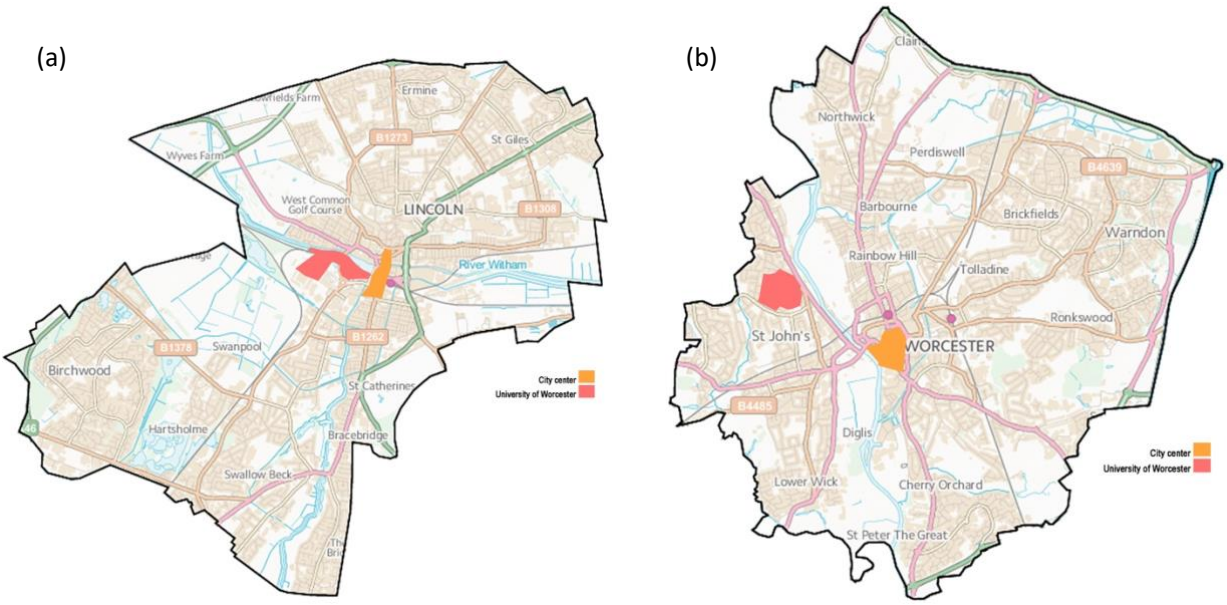


Figure 1- (a) campus and city center locations in city of Lincoln, UK modified form ordnance survey, 2015; (b) campus and city center locations in city of Worcester, UK modified form ordnance survey, 2015.

3.2 CITY OF WORCESTER AND UNIVERSITY OF WORCESTER

Worcester is a historical, cathedral city, which is located at the middle of Worcestershire, UK (Figure 1b). Worcestershire is part of the West Midlands. The city itself is about 30 miles Southwest of Birmingham and twenty-seven miles north of Gloucester (refxx). Worcester city is spread around 33.28 square kilometres and population is around 102,100 in 2016 (Lemon, 2017). The highest number of the inhabitants of the city is comprised of the young personnel and this accord a unique potential to the city (ref xx). The history of the University of Worcester had started during 1946 (University of Worcester, 2009). At that time the, University of Birmingham opened the new branch of Emergency Teacher Training in Worcester during the Second World War (University of Worcester, 2009). In 1976, this branch was granted to change the title to Worcester College of Higher education (University of Worcester, 2009). After the alteration of the title, the collage brought the new organisation which was based on different departments such as Arts and Science, Teaching Studies and Education. In 1992, the Coventry University accepted the validated the degree courses for the Worcester College and after few years, in 1995, two more colleges (Worcestershire College of Nursing and Herefordshire) were merged with Worcester College of Higher Education (University of Worcester, 2009). In 1997, The Worcester College of Higher education became the University of College Worcester. By 2005, the University was officially granted the university title and changed the title to University of Worcester (University of Worcester, 2009). The Worcestershire city council and the University of Worcester had a collaboration to create a new library named Hive library which was opened in July 2012 (Willetts, 2014).

4. ANALYSIS

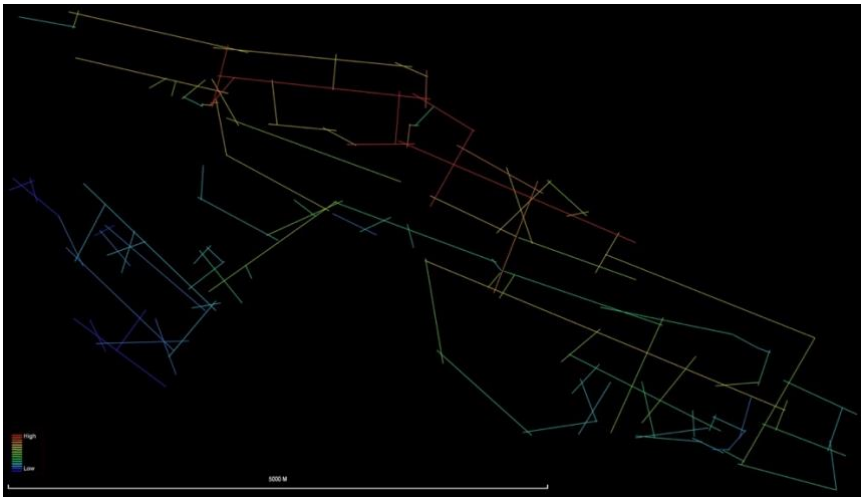
4.1 SYNTACTIC ANALYSIS OF UNIVERSITY CAMPUSES AND CITIES

In this research, the spatial analysis focus on the integration between the university campuses and their neighbourhood and how they relate to the physical location of the university within the city. Integration measure is a major means of investigation to show potentiality of the surrounding (Hillier and Hanson, 1984).

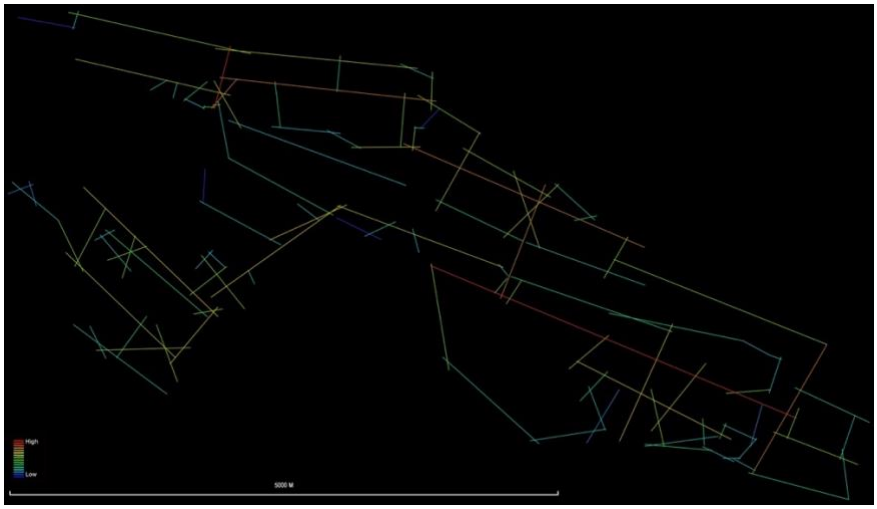
Figure 2 illustrate the global and local integration of University of Lincoln. As global integration [HH] shows along the campus way and along the route that connects the Minerva building to the campus way, more integration is visible than anywhere else in the rest of the University (Figure 2a and 2c). On the other hand, spaces around the Shallotte Scott Building appear to have no integration with other parts of the University. The space syntax shows that the north side of the University has more integrated space when compared to the southern side (Figure 2). This difference in integration will be due to the restricted access of the northern side of the University. The restriction takes in this case is Brayford pool and railway line (Figure 2c). The local integration [R3] is the most pronounced along the route that connects the library to the pavilion accommodation (Figure 2b and 2c). This is followed by the foot bridge which connects the northern side of the campus to the southern side by traversing the railway lines in between. Of equal integration to the railway bridge is the Campus Way, which is a road that serves access to the Student Village to the west of the campus (Figure 2b and 2c). A third location shows equivalent integration to both the railway bridge and Campus Way. According to the data the results show that the rest of the University campus has much less integration than these four sites. The bi-plot illustrated the relationship between global and local integration [R3] in University of Lincoln with the correlation coefficient R^2 to be weak, recorded at (R2= 0.276, Table 1).

Figure 3 demonstrate the integration analysis for 2 km around the university of Lincoln campus within the city. The data analysis of the city and its relationship to the University shows that the location of the University is of particular importance to how the city functions. The University of Lincoln merges seamlessly with the city because it is ungated and the campus is located within the heart of the city. The data analysis of the city of Lincoln (Figure 3a) displays that in the pattern of global integration [HH], the High street is the highest value in the system. Because it is a pedestrianised route that has served off street access for other roads within its University. In Lincoln, the university campuses link to a system with street that has high value, which includes St Mark street and High street (Figure 3a). Additionally, aforementioned the routes are connecting the University campus to the High street. Almost all of the areas around the High Street are well integrated. Looking at an overview of the city, from a range of 2 km around the campus as shown in (Figure 3), display insufficient integration of the area of the city of Lincoln both on the local and global scales. In both the global and local analysis the High Street is the most integrated space. The research data also shows that in both analyses, the University has an average integration with the city (Figure 3). The less integrated spaces appear in locations which are distributed evenly across the city whilst the city itself is well integrated (Figure 3). Overall, the system is high synergy (R^2= 0.632), which suggests that there is a high correlation between global and local integration [R3] in the city of Lincoln (Table1). The bi-plot shows that the scattering of all the points in the system is around the regression line (Table1). This implies a strong relationship between the global and local integration.

(a)



(b)



(c)

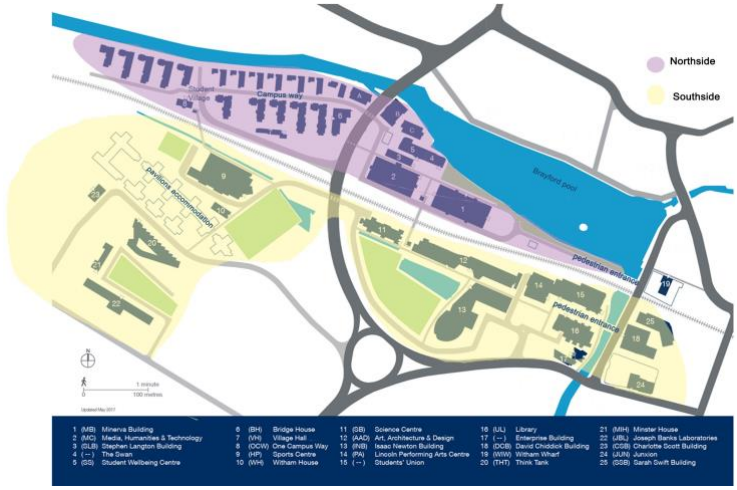


Figure 2- (a) Global integration [HH] in the University of Lincoln; (b) Local integration [R3] in the University of Lincoln; (c) University of Lincoln campus map Modified from University of Lincoln, 2017.

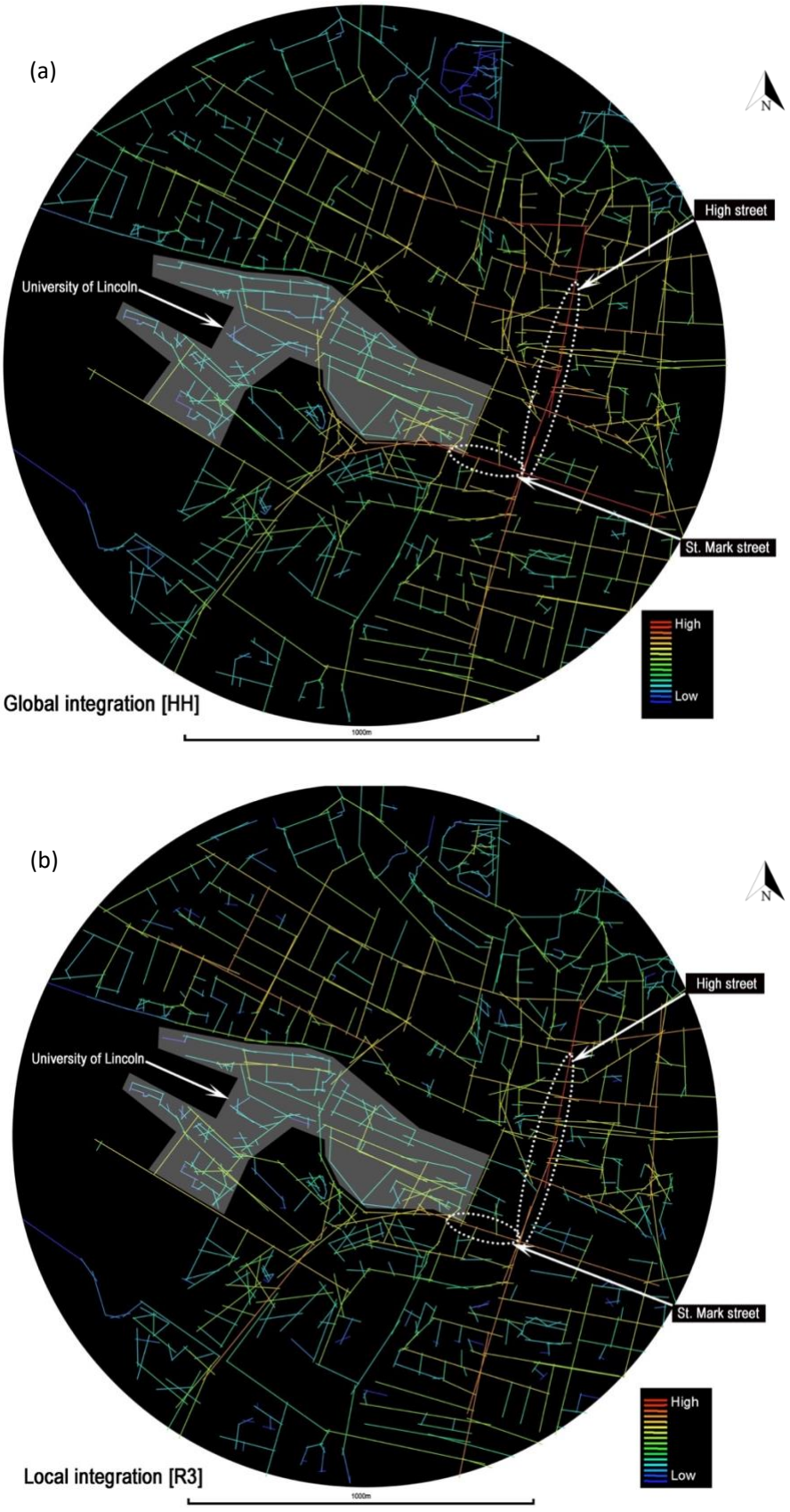
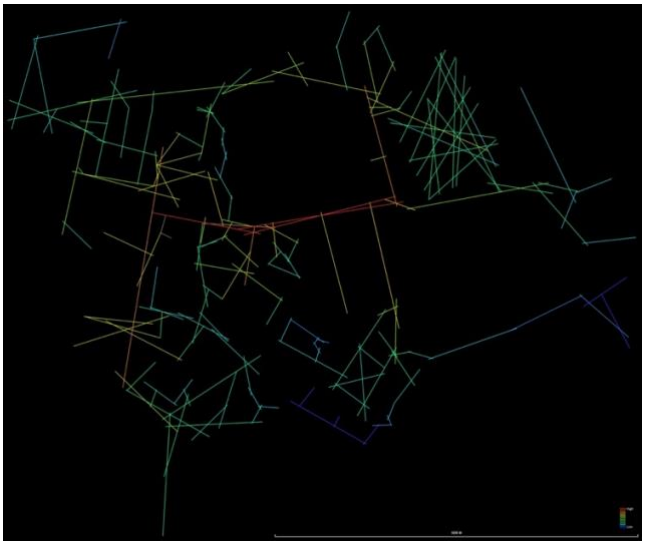


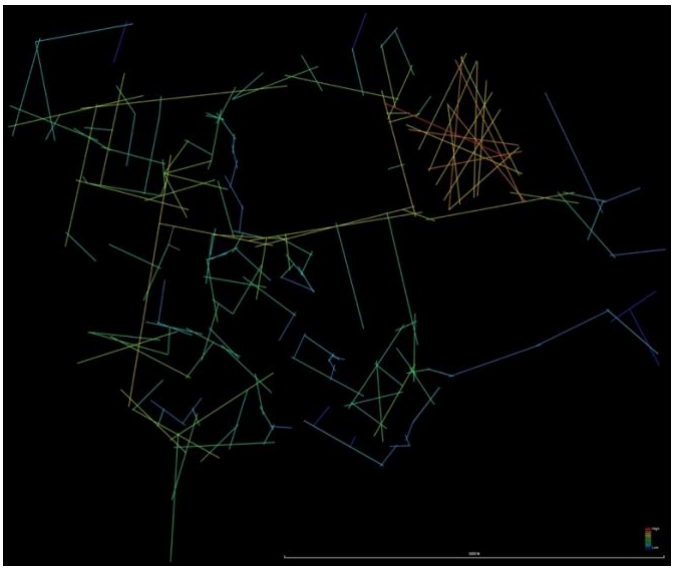
Figure 3- (a) Global integration [HH] in City of Lincoln; (b) Local integration [R3] in City of Lincoln.

Figure 4 illustrate the global and local integration [R3] analysis of University of Worcester campus. The global integration [HH] shows high integration along the campus way: from the car park in North East of campus to Thomas Telford Building (Figure 4a and 4c). This is following by a goon integration on the route from: St John's Halls in the North East of the campus near to long-term parking and the path between the library building and St John's Halls in the North West of campus (Figure 4a and 4c). On the other hand, the spaces around the Sheila Scott building and the paths around the Drawing building appear to have no integration with other parts of the system. As Figure 4b shows the local integration [R3] is the most pronounced in the parking area in the Eastern side of the campus. The other areas in the campus have moderate integration such as the path from the library towards the St. John's Hall and the path between the car park in the eastern side to the Thomas Telford Building (Figure 4b and 4c). Generally, the local integration [R3] analysis for the campus shows that the University has an average integration (Figure 4b). The correlation between the global and local integration [R3] of the University is moderate R^2= 0.468 (Table 1). As the bi-plot demonstrated the University of Worcester has a moderate correlation between global and local integration.

The relationship between the University campus and city is mostly related to the location of the University and to the design of the gated University campus. The University of Worcester surrounded by residential area and is restricted by walls. This is inevitably condition a less solid relationship between the city and the University campus. Figure 5 shows the integration analysis of 2 km around the university campus within the city. The data analysis of the city of Worcester shows (Figure 5a), in global integration [HH] scale the main road that goes from the south part of the city towards to the north of the city (Hylton road) is most integrated space in the city. The city is divided by the River Severn into eastern and western part. The analysis shows that the western part is well integrated (Figure 5a). However, the results from the local integration [R3] are slightly different than the global integration [HH] for the city. The local integration [R3] analysis (Figure 5b) displays how the integration of spaces stronger on the eastern part compares to the global. On the other hand, the most integrated spaces in the system belong to the campus. However, the connection routes between the University and the surrounding areas are not substantial correlation spaces in the system. From an overall perspective of the local integration, the western part of the city is poorly integrated comparing the east part. The correlation between the university and the city in global integration [HH] displays a below average integration of the University campus in the system. The analysis of the relationship between the global and local integration [R3] in city of Worcester present the weak correlation (R^2= 0.1444)



(a)



(b)

(C)

Figure 4- (a) Global integration [HH] in the University of Worcester; (b) Local integration [R3] in the University of Worcester; (c) University of Worcester campus map (University of Worcester, 2017).

Case studies	Global integration [HH]			Local integration [R3]			Intelligibility (R^2)
	Minimum	Average	Maximum	Minimum	Average	Maximum	
City of Lincoln	0.427925	0.809426	1.44871	0.333333	1.45833	3.57385	0.558316
University of Lincoln	0.353234	0.41438	0.860316	0.422392	0.99071	2.58177	0.276265
City of Worcester	0.294194	0.535158	0.841448	0.333333	1.46454	3.22889	0.144475
University of Worcester	0.419334	0.964176	1.68572	0.527991	1.74063	3.59989	0.468213

Table 1- Comparison between city of Lincoln, University of Lincoln, city of Worcester and University of Worcester including Intelligibility (R^2) and integration measures- both global and local values.

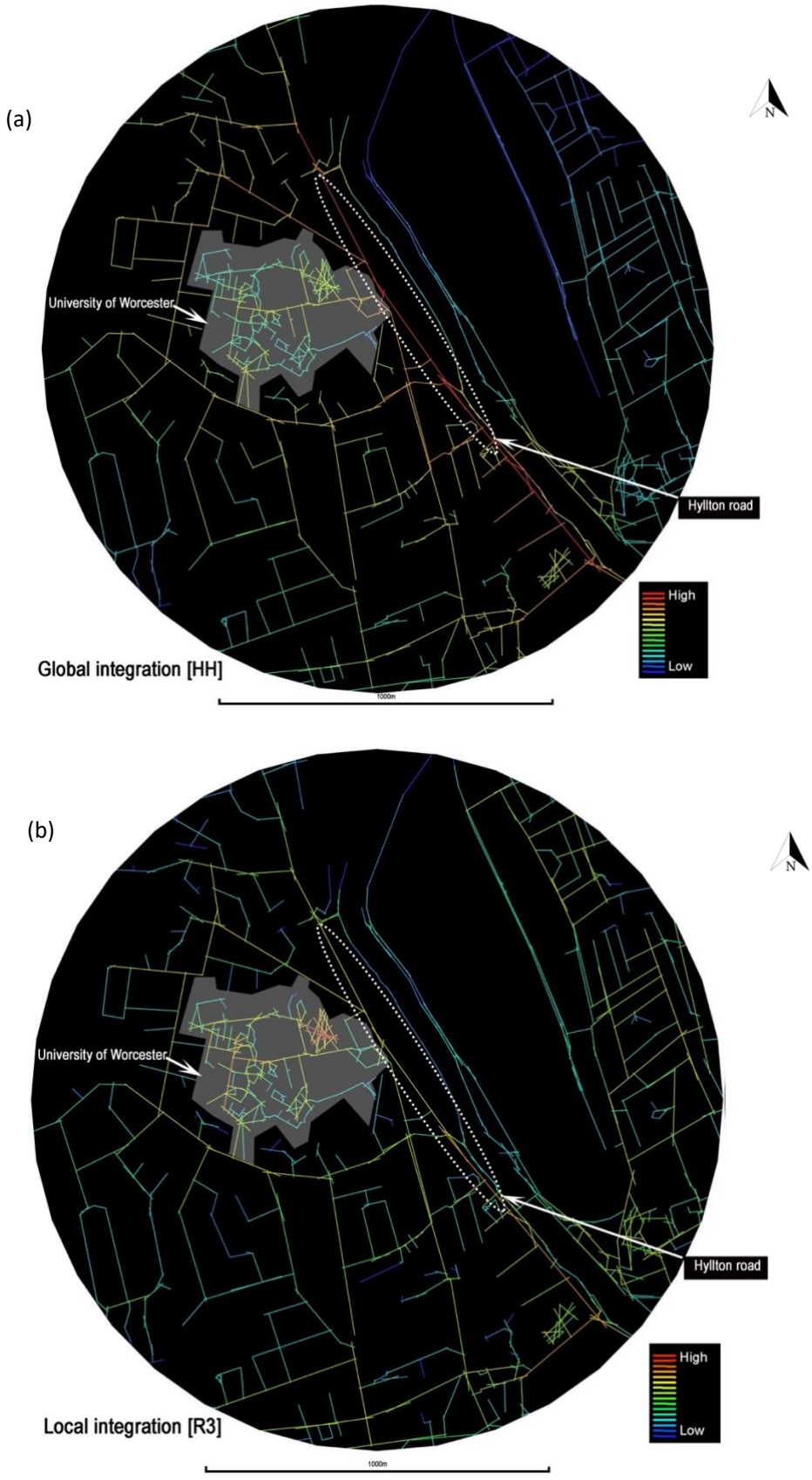


Figure 7- (a) Global integration [HH] in the city of Worcester; (b) Local integration [R3] in the city of Worcester.

4.2 OBSERVATION DATA

In order to investigate the relationship between the university campus and the city in a greater depth, the observation (gate count method) were conducted in the both case studies. The gates are intersections of fore ground and background network of cities according to both global and local integration [R3] and the connection route between the university campus and the city center. An observation similar to the one at Lincoln was carried out, her observation counted the number of objects passing through the gates in the timespan of 5-minutes. Samples were taken from each gate in 4 cycles throughout the specific days – Monday, Wednesday, Friday and Saturday –, from 8 am to 4 pm, over the course of a week in both cities.

According to the results (Figure 6a), in city of Lincoln the Gate 6 leads with the highest amounts of movement in a weak while the gate 1 leads the lowest amounts of passers-by. The rest of gates shows the average amounts of movement around the University campus. Therefore, in city of Worcester (Figure 6b), the observation results illustrate that the fewest amounts of movement is the entrances of the University campus (Gates 1and 2). A similar pattern shows in Gate 4, which shows the least amount of movement. This Gate is located on a pedestrian bridge, which connects the West part of the city to the East Gate 4. The data illustrate that in city of Worcester, from the university towards the city center, the number of users increase. These finding from both case studies may suggest that the physical location of university and the type of Campus are effect on activities in the city. According to Hillier (1996), the improvement of the spatial structure of urban environment depends on busier and quieter movement pattern flows in areas, and these patterns influence land use decisions. As the data shows, the location of university campuses has a significant impact on these patterns.

Figure 6- (a) Illustration of observation data for campus area in city of Lincoln; (b) Illustration of observation data for campus area in city of Worcester.

4.3 CENSUS DATA

In order to understand socio-economic impact of university in the city it is important to looks at university campuses with respect to the socio-economic relationship within the city. For the purpose of this research crime rate, average income and average house price determined from 2008 to 2016. Figure 7 illustrate the average of house property in both city of Lincoln and city of Worcester in past decade. It is clear to see that the average of house price increased by around 17% at city of Lincoln whereas, in city of Worcester increased by 14% (Official labour market statistics, 2018). Differently, looking at crime rates, in city of Lincoln the rate of crime decreased grammatically approximately an 8% while in city of Worcester the crime gradually increases with proximately 8.4% in total (UK crime stats, 2018). Lastly, Figure 7 depicts the income for both case studies (Official labour market statistics, 2018). city of Worcester has higher incomes compare to Lincoln, while the rate of house price in city of Lincoln in slightly higher than city of Worcester. Overall, the data may suggest that (specially for city of Lincoln) both cities have improved as a social and economic gradually and university campuses are part of that development. For instant, University of Lincoln invested £1200 million in the new campus in Brayford Pool. Plus, that money spends on new strategies for transforming the city centre area which includes revitalising the area and attracting private investment for opening new businesses and sectors economic growth rates (University of Lincoln, 2015). Regional economic analysts have estimated that the University of Lincoln has created at least 3,000 new jobs within Lincoln, and that it generates more than £250 million every year for the local economy doubling previous local economic growth rates (University of Lincoln, 2015). Similarity, Since University of Worcester gained full University title has an impact on region's economy. By 2012, the University contributed proximity £250 millions to the region's economy (University of Worcester, 2009). The most important impact that University of Worcester has on the city is Hive library. In fact, the facilities of Hive library have an excellent impact on both academic and non-academic inhabitants such as increased learning Sources through technology (Rodgers, 2014). The university's inspirational new library, known as the Hive, is the first joint university and public library in Europe (Hannaford & Fairman, 2012).This collaboration between the University of Worcester and Worcester City Council has helped the university and city to bring the local and students community together. As a public as well as university facility, The Hive has achieved its vision to inspire the people of the region to read for enjoyment and for education. Since it opened, book borrowing and library visitor numbers have soared, with an increase of over 200% in the number of books issued, and a 100% plus increase in visits compared to the previous public Worcester Library (University of Worcester, 2015).

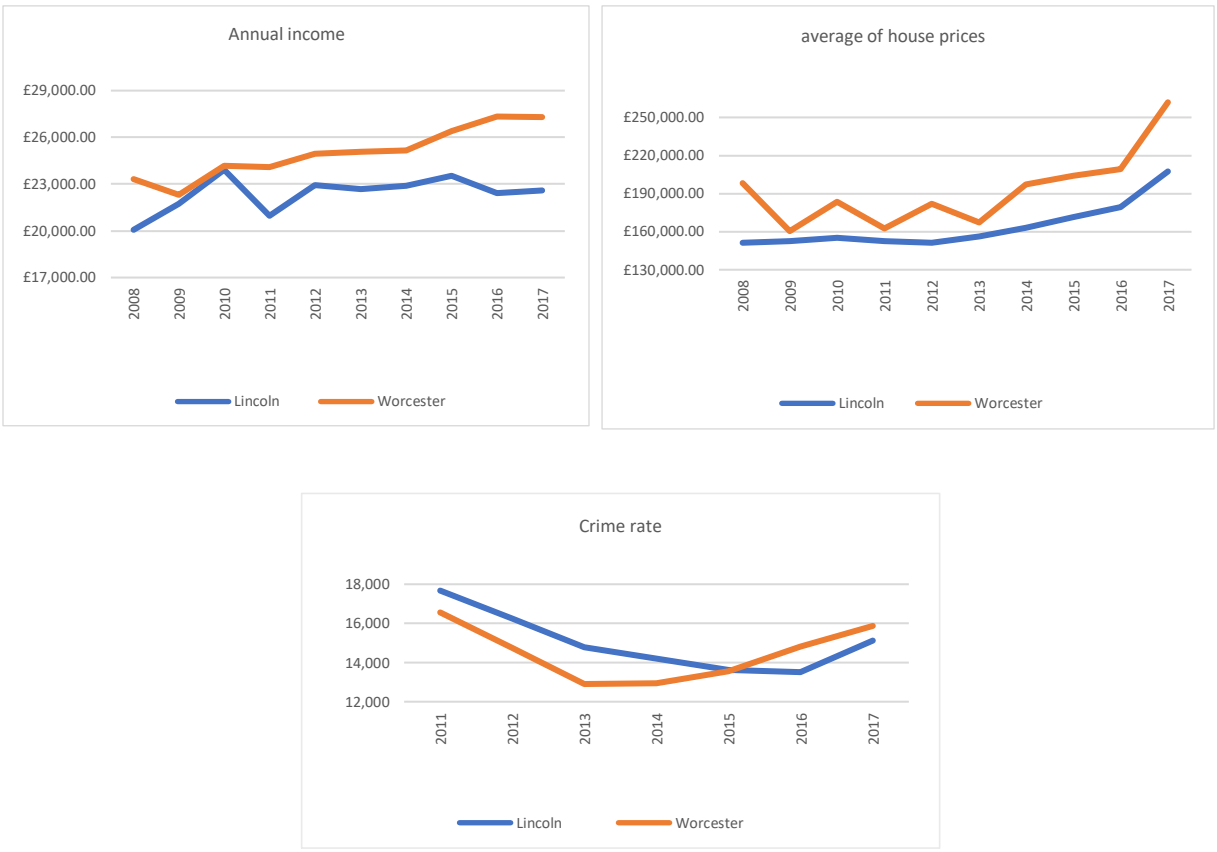


Figure 7- compression of Annual income, average of house price and crime rate between city of Lincoln and city of Worcester (official labour market statistics, 2018; UK crime stats, 2018).

5. DISCUSSION

The observation data and analysis demonstrate that the University of Lincoln area has diversity in people activity rather than the other campus. It is clear when looking for integration values, the city of Lincoln has high value in both global and local scales, while the city of Worcester is based more on a local scale. So, since the University of Lincoln is an integrated-city campus, this suggests that the University of Lincoln has more possibilities to connect across the neighbourhoods. However, it is important to note that just because the possibilities to connect to other surrounding areas, that does not mean that such connections will be established. For example, the observation data illustrate that the movement around the University of Lincoln is higher than the inside the campus area. In addition to this, the high correlation between the global and local values in the city of Lincoln suggests that the good relationship between the university campus and city in this case study. Whereas, the relationship between the University of Worcester and the city of Worcester demonstrate that the low correlation between the local and global scales. This is suggesting that there is less possibility to have a strong relationship between the campus and the surrounding area. Despite the fact that the University of Worcester surrounded by residential area and it is a gated within the city campus, the observation data shows that the more activity is based near to the city centre where the Library is located. However, with the knowledge of the university campuses are include students' movement and this movement is almost a daily bases schedule, the University of Worcester campus it might be the reason for enhancing the potential routine movements in a neighbourhood area.

Syntactic analysis shows that the University of Lincoln located in the accessible locations in the city with no restricted gate surrounded which is open for both students and non-students to use the space inside the campus. However, the results from the university campus itself in both integration measures and observation illustrate that campus has less values to compare to the city. On the other hand, the University of Worcester campus itself shows different results. The university campus results demonstrate higher values correspond to the city. It might suggest that the integrated-city campuses (such as University of Worcester) have own strong structure inside the campus and work as one system internally, but when combined with the neighbourhoods, the relationship between the university campus and surrounding area as one system is weak. This study has used different methodological tools in Space Syntax with the aim to answer the relationship between the university and the city. Form the data results; it can be determined that the most important elements for this relationship are the spatial configuration and the physical location of the university. For example, the University of Worcester campus (as a gated within the city campus) has higher integration value as one system, while the University of Lincoln campus (integrated-city campus) of less integration. But these results totally change when looking for the relationship within the surrounding area. The result of this relationship determined that the city of Lincoln has a higher integration value that the city of Worcester.

6. CONCLUSION

The relationship between the university and the city is the complex relationship, that is dependent on many physical and non-physical variables. This study aims to uncover the relationship between the university campus and the city influence of the physical location of campuses within the city. The urban structures of the two cities were investigated to understand more about their relationship related to how campus layouts influence the spatial configuration of the city. In order to understand the relationship between city and university campus the means of Space Syntax and observation data provided. By using the integration values and the correlation between global and local integration, it can be suggested that there are more possibilities for the University of Lincoln to connect with the surrounding area in the city due to the higher correlation value between global and local integrations. However, the University of Worcester (as a gated within the city campus) reveal that there is more relationship inside the campus due to the higher correlation between the global and local integration when is focusing on the university campuses itself. The combination of the integration value and observation data, it can suggest that the spatial morphology and physical location of campuses are the most influential factors on the physical relationship between the city and university. But these are not the only factors, the collaboration between university and city in terms of socio-economic factors has an impact on this relationship.

REFERENCES

Ansell, M. (2017). Universities and cities: Building stronger communities. Going Global. Cape Town: British Council.

City of Lincoln Council. (2013, May). City of Lincoln Council. Retrieved December 10, 2015, http://www.lincoln.gov.uk/business/city-centre-masterplan/downloadable-documents/

City of Lincoln Council. (2016). The Lincoln City Profile – 2016. Lincoln: city Lincoln council.

Dawson, P. C. (2003). Analysing the effects of spatial configuration on human movement and social interaction in Canadian Arctic communities. 4th International Space Syntax Symposium. London.

Elnokaly, A., & Elseragy, A. (2012). Historic city centres as catalysts for wider sustainable urban regeneration. In Requalifying the Built Environment: Challenges and Responses. Advances in People-Environment Studies (pp. 30-49). Hogrefe Publishing GmbH Merkelstr.

Glaeser, E. L. (1998). Are Cities Dying? Journal of Economic Perspectives, 12(2), 139-160.

Goddard, J. (1994). Universities and communities. CVCP.

Graser, A. (2013). Learning QGIS 2.0. Packt Publishing.

Haggans, M. (2015). the Physical University: Contours of space and place in higher education. On the Horizon, 23(1), 72-74.

Hajrasouliha, A. H. (2016). Campus does matter: The relationship of student retention and degree attainment to campus design. Planning for Higher Education, 44(33), 30.

Hajrasouliha, A. (2017). Campus score: Measuring university campus qualities. Landscape and Urban Planning. Landscape and Urban Planning, 166-176.

Hannaford, A., & Fairman, R. (2012, 1 24). The Hive: a new university/public library and history centre, Worcester UK. Retrieved 11 7, 2017, from https://eprints.worc.ac.uk/id/eprint/1532

Heijer, A. (2008). Managing the University Campus in an Urban Perspective: Theory, Challenges and Lessons from Dutch Practice. In: Corporations and Cities: Envisioning Corporate Real Estate in the Urban Future. 2008.

Heijer, A. C. (2011). Managing the University Campus: Information to support real estate decisions. Eburon Uitgeverij B.V.

Heijer, A. C., & Magdaniel, F. T. (2012). The university campus as a knowledge city: exploring models and strategic choices. Knowledge-Based Development, 3(3), 283-304.

Hermke, & Helsper, M. (1990). The Auraria campus: An example of American landscape design. Landscape and Urban Planning, 19(1), 1-16.

Hillier, B., Leaman, A., Stansall, P., & Bedford, M. (1976). Space Syntax. Environment and Planning B: Urban Analytics and City Science, 3(2), 147-185.

Hillier, B., & Hanson, J. (1989). The Social Logic of Space. Cambridge University Press.

Hiller, B. (1996). Space is the machine: A Configurational theory of architecture. Cambridge: Cambridge University Press.

Hillier, B. (2008). Space and spatiality: what the built environment needs from social theory. Building Research & Information, 36(3), 216-230.

Kemp, D. (1992). The Pleasures and Treasures of Britain: A Discerning Traveller's Companion. Canada: Dundurn.

Kim, Y. O. (1999). Spatial Configuration, Spatial Cognition and Spatial Behaviour: the role of architectural intelligibility in shaping spatial experience. Retrieved January 23, 2016, from http://discovery.ucl.ac.uk/1317973/

Lau, S. S., & Yang, F. (2009). Lau SS, Yang F. Introducing healing gardens into a compact university campus: design natural space to create healthy and sustainable campuses. Landscape Research, 34(1), 55-81.

Lemon, S. (2017). Population Statistics Available from http://www.worcestershire.gov.uk/info/20044/research/795/population_statistics/2 [accessed 17 November 2018].

Macionis, J. J., & Parrillo, V. N. (2016). Cities and urban life (7 ed.). Pearson Education.

Mathur, V. K. (1999). Human capital-based strategy for regional economic development. Economic Development Quarterly, 13(3), 203-216.

Office For National Statistics. (2012). 2011 Census. Retrieved 02 2016, from http://www.ons.gov.uk/ons/guide-method/census/2011/index.html

official labour market statistics (2018). Area reports - Nomis - Official Labour Market Statistics Available from https://www.nomisweb.co.uk/home/profiles.asp [accessed 15 November 2018].

Oxford Economics. (2017). The economic impact of universities in 2014–15. London.

Penn, A. (2003). Space Syntax and Spatial Cognition or Why the Axial Line? Environment and Behavior, 35(1), 30-65.

Rauch, J. E. (1993). Productivity gains from geographic concentration of human capital: evidence from the cities. Journal of Urban Economics, 34(3), 380-400.

Robert, B. (2001). Designing the university campus: It matters. Phi Kappa Phi Forum, 8(3), p. 8.

Rodgers, K. (2014). Worcester's Hive. Retrieved 10 12, 2016, from http://www.buildingtoday.co.nz/LatestNews/Magazine/tabid/8136/ArticleID/10250/Default.aspx

Simon, C. J. (1998). Human capital and metropolitan employment growth. Journal of Urban Economics, 43(2), 223-243.

Stachniss, C., Schill, K., & Uttal, D. (2012). Spatial Cognition VIII: International Conference, Spatial Cognition 2012, Kloster Seeon, Germany, August 31 -- September 3, 2012, Proceedings. Springer.

The Independent. (2014, July 16). Lincoln, University of. The Independent. Retrieved from http://www.independent.co.uk/student/into-university/az-uni-colleges/lincoln-university-of-754709.html

UK crime stats (2018). UKCrimeStats.com - The Leading Independent Crime Data Platform Available from http://www.ukcrimestats.com/Search/ [accessed 17 November 2018].

Universities UK, 2015. (2015, June 11). The economic role of UK universities. Retrieved 10 13,2017, from http://www.universitiesuk.ac.uk/policy-and-analysis/reports/Pages/the-economic-role-of-universities.aspx

University of Lincoln. (2015). Key Facts About the University of Lincoln. Lincoln: Press & Media Office.

University of Worcester. (2009). History of Worcester Royal Infirmary to Be Brought Back to Life. Retrieved 10 12, 2016, from https://www.worcester.ac.uk/discover/history-of-worcester-royal-infirmary-to-be-brought-back-to-life.html

University of Worcester. (2015). University of Worcester. Retrieved 9 15, 2016, from https://www.worcester.ac.uk/your-home/the-hive.html

University of Lincoln (2017). University of Lincoln Campus Map.

University of Worcester (2017). St John's Campus Map - University of Worcester Available from https://www.worcester.ac.uk/documents/st-johns-campus-map-university-worcester-web.pdf [accessed 2017].

Vallance, P., & Goddard, J. (2013). The University and the City Regions and cities. Oxon: Routledge.

Vaughan, L. (2001). Space Syntax observation manual. London: UCL. Retrieved from file:///Users/13506511/Downloads/Observation_manual.PDF%20(3).pdf

Walford, N., Samarasunderaa, E., Phillips, J., Hockey, A., & Foreman, N. (2011). Older people's navigation of urban areas as pedestrians: Measuring quality of the built environment using oral narratives and virtual routes. Landscape and Urban Planning, 100(1-2), 163-168.

Way, T. (2016). The urban university's hybrid campus. Journal of Landscape Architecture, 42 55.

Wiewel, W., & Perry, D. C. (2015). Global Universities and Urban Development: Case Studies and Analysis. Oxon: Routledg.

Willetts, D. (2014). Contribution of UK universities to national and local economic growth. Department for Business, Innovation & Skills.